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REMOTE SENSING AND REMOTE CONTROL ACTIVITIES  
IN EUROPE AND AMERICA: PART II--REMOTE SENSING  
GROUND STATIONS IN EUROPE

by

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REMOTE SENSING AND REMOTE CONTROL ACTIVITIES  
IN EUROPE AND AMERICA: PART II--REMOTE SENSING  
GROUND STATIONS IN EUROPE

Shi Changjie

Science and Technology Committee  
Aerospace Industry General Corporation

Development tasks and products of remote sensing ground stations in Europe are represented by the In-Sec Corporation and the Schlumberger Industries Corporation. The article presents the main products of these two corporations.

I. TM89000 Remote Sensing Ground Station of In-Sec Corporation, in France

The TM89000 is a modularized and open-type remote sensing system using trunk lines. Fig. 1 is a block diagram of this system. The system hardware includes: PCM image frame, data base for synchronizing of PCM frame with subframes and demodulation, simulation input and output, VI trunk line, system control, algorithm processing, time marking, hard disk, printer, Ethernet, workstation, digital tape control, hard disk control, and special control interface. The station has functions of real-time

display and real-time processing.

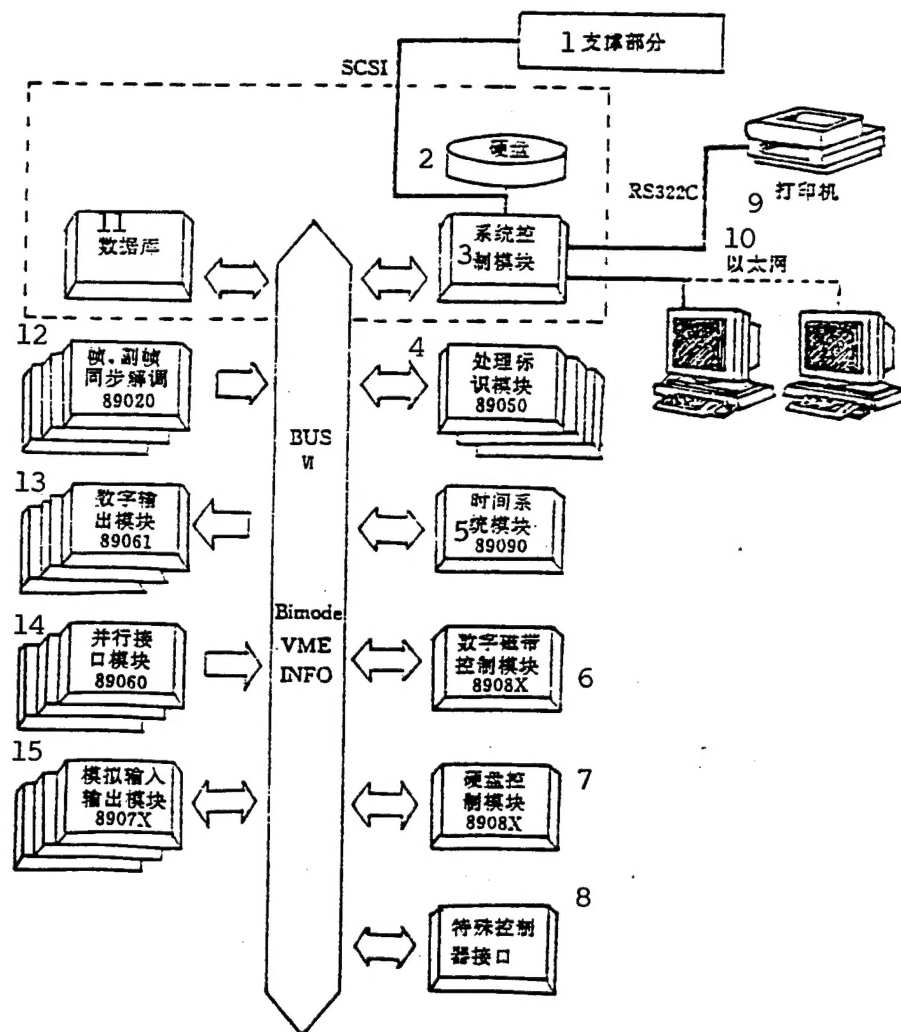


Fig. 1. Block diagram of TM89000

KEY: 1 - support section 2 - hard disk 3 - system control module 4 - processing marking module 5 - time system module 6 - digital magnetic control module 7 - hard disk control module 8 - interface for dedicated controller 9 - printer 10 - Ethernet 11 - database 12 - synchronous demodulation of frames and subframes 13 - digital output module 14 - parallel interfacing module 15 - analog input and output module

### 1.1. Synchronizing and demodulation PCM frames and subframes

The ground station can support IRIG, Daniel, and CE83 remote sensing standards. The maximum data rate can be as high as 10Megacodes/s, capable of real-time switching of four formats. Each code length is variable between 1 to 32 digits with over limit inspection.

### 1.2. Simulation input and output

The ground station has 16 high-speed simulation channels; the sampling rate of each channel can be as high as 100,000 sampling points with their respective sampling maintenance circuits. There are 16 digital to analog converters, capable of providing 16 parameters in the simulation form for peripherals.

There is a superhigh-speed simulation module, capable of sampling four input signal channels with each signal channel having as much as 4M sampling points. The input data is converted to 12-bit digital data with over-limit inspection.

### 1.3. Time marking

This provides IRIG A, B, C, and G time codes with resolution as fine as 1ms, with precise marking of time capability on input parameters. With respect to some high-speed data transmission channels, very precise time correlation can be ensured.

### 1.4. Real-time processing

Real-time processing on parameters is feasible. As to the results after processing and calibration, retransmit the results of some parameters with inductive computations to the trunk line to be outputted.

### 1.5. Real-time display

The application performance is good; the low-cost X11 terminals are connected via Ethernet. Such terminals can also be replaced with color workstations with high resolution color workstations with UNIX-S/Windows system software. By RS-232 interface, eight types of personal computers are compatible.

### 1.6. VI Trunk line

There are two forms of VI trunk line. One is of the VME form, capable of fitting multiple VME modules. The other form is of the information form, suitable for transmitting large-capacity remote sensing parameters.

Each sampling module with marking symbols is used for data transmission through the VI trunk line. The VI trunk line passband is very wide, at 10M characters per second with very small phase error. All modules on the trunk line monitor data on the trunk line to have a response according to the specified marking symbol protocol, such as preprocessing. After processing, marking symbols are reset in the data, to be transmitted again to the VI trunk line for distribution. The trunk line provides 32-bit data, along the transmission of floating-point data and time code. Based on the required processing capability, modules can be arranged.

### 1.7. Memory and retransmission

By using different media in the peripherals, such as optical disk, magnetic disk, and digital magnetic tape, many versions of the control drivers can operate simultaneously, to match with the

collection speed. The post-compression data can be stored in memory; also the data can be converted to specific user format before storing.

#### 1.8. System software and application software

The system software applies UNIX/TCP-IP/X-Window. Software of the real-time processor is compiled in C language. There are various standard algorithmic databases. A user can request to have additional algorithms based on his requirements.

#### 1.9. Database management

There is a rapid increase in the number of parameters to be preprocessed with respect to the remote sensing parameters. Therefore, a database management module was designed. The module has the function of over-threshold inspection, other than for database management. Thus, data input and output are greatly increased.

#### 1.10. Status arrangement

The menu was reduced to the minimum. The screen has high compressive functions for rapid status settings.

#### 1.11. Computer interface

The DMA interface and Ethernet are used for interfacing with the computer.

#### 1.12. Machine case

A 19-inch standard machine case is six units high, capable of accommodating a 340MB hard disk.



## II. Delta6000 of Schlumberger Industries Corporation

The Delta6000 is a modularized and open-type remote sensing system with trunk lines. There are two parts to the fundamental layout: the first part is the remote sensing front end with VME trunk line machine housing. Collection and preprocessing are carried out with VME and VSB trunk lines. The second part includes the UNIX workstation and Delta software, for the front-end layout, with functions of parametric display, data storage, and data retransmission. Figs. 2 and 3 are block diagrams.

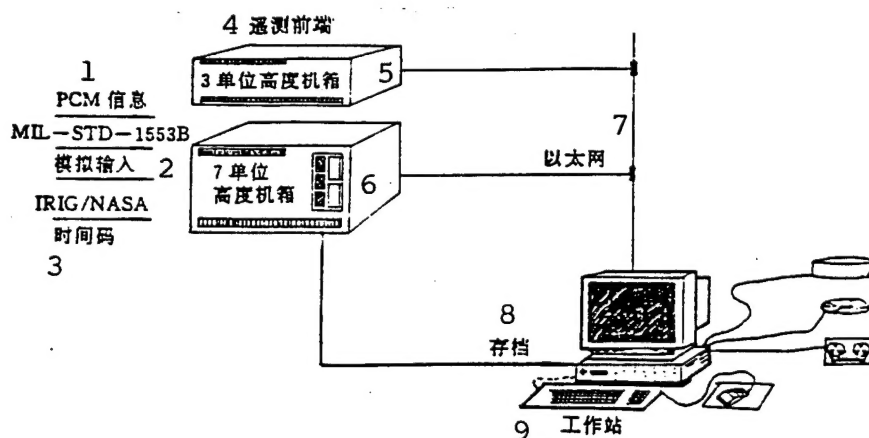


Fig. 2. Remote sensing front-end and workstation

KEY: 1 - signal 2 - analog input 3 - time code 4 - remote sensing front end 5 - three-unit high machine case 6 - seven-unit high machine case 7 - Ethernet 8 - filing 9 - workstation

### 2.1. Data collection

Eight data streams can be simultaneously inputted, with all kinds of PCM systems, capable of working with such remote sensing standards as IRIG, CE83, and Daniel. Each sampling point is indicated by 4 to 32-bit code. Code synchronization can be as

high as 10megacodes per second; frame synchronization can be as high as 15megacodes per second. Random postprocessing data with time code data can be received. The maximum number of channels at the simulation parameter input terminal is 256; the maximum rate is 1M sampling points per second per channel. Such standard signals as MILSTD1553, and Arinc 429 and 629 can be received. Four to 16 channels of multichannel IRIG modulation signals can be received. There are PSK and FSK demodulators, capable of receiving such standard time codes as IRIG A, B, and C, as well as NASA36.

The expanded version can receive CCSDS standard signals. The convolutional code is  $(7,1/2)$  15megacodes per second. The RS code is (223, 255) and 1 to 5 alternations, capable of random solution. There are uplink signal channels.

## 2.2. Data preprocessing

Conversion of engineering units can apply 46-point table lookup or one to five-order polynomials. It is feasible for data compression and the calculation with inductive parameters. Filtering and alarming are feasible, with a standard algorithmic base. Algorithms can be compiled on user's specific request.

## 2.3. Software

Solaris, OsF, and HP-UX.

Oracle (SQL) database software.

VxWork real-time Os software.

DV-tool graphics software.

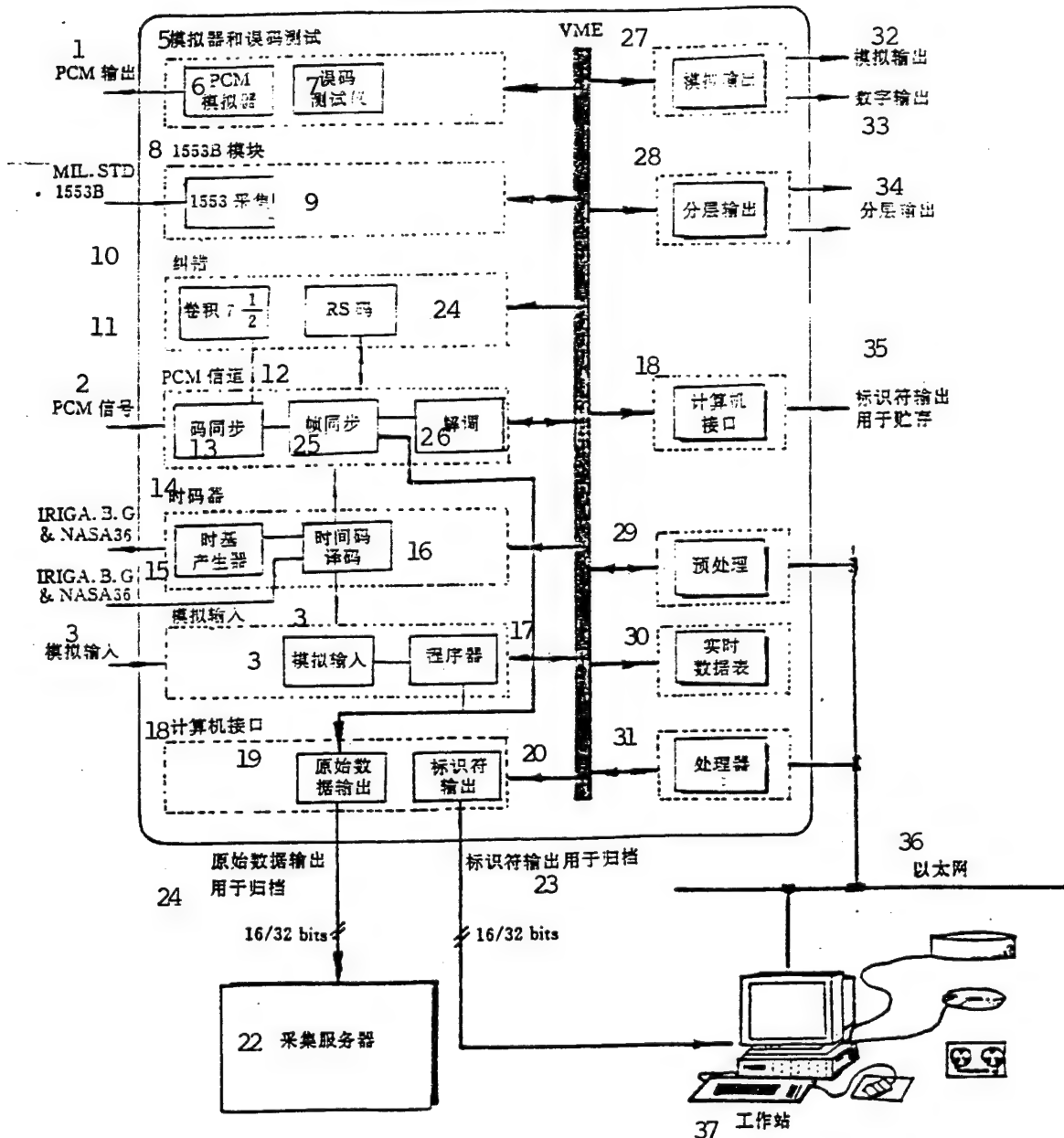


Fig. 3. Remote sensing front end, DELTA6000  
 KEY: 1 - output 2 - signal 3 - analog input 4 - remote sensing front-end 5 - analog device and error code testing 6 - analog device 7 - error-code test instrument 8 - module 9 - collection 10 - error correction 11 - convolution 12 - signal channel 13 - code synchronization 14 - time coding device 15 - time base generator 16 - time code translation 17 - serial device 18 - computer interface 19 - output of original data 20 - output of marking symbols 21 - output of raw data for filing 22 - collection servicing apparatus 23 - output of marking

symbols for filing    24 - RS code    25 - frame synchronization  
26 - demodulation    27 - analog output    28 - layer-by-layer  
output    29 - preprocessing    30 - real-time data lookup table  
31 - processor    32 - analog output    33 - digital output  
34 - layer-by-layer output    35 - output of marking symbols for  
filing    36 - Ethernet    37 - workstation

#### 2.4. Application software

Storage retransmission software, real-time display software, collection and storage software, and time parametric analysis and utilization software.

#### 2.5. Output interface

Layer-by-layer signal interface, analog signal interface, digital signal interface, RS-232 interface, and Ethernet interface.

Data is between 16 and 32 bits; marking symbols are between 16 and 32 bits.

#### 2.6. Workstations

Multiple UNIX workstations can be used, such as: Sun Spar 2 or 10, DEC 5000, HP 9000 series 400 or 700, and X terminals.

#### 2.7. Computer interface

The interface can be applied to Sun, VAX, Encore, Aptec, CCC (Concurrent Computer Corporation), and HP computers.

#### 2.8. Communication Interface

There are audio frequency and video frequency interfaces for Ethernet, TCP-IP, UDP, FDDI, SCSI-2, RS232 C/RS423, and RNIS.

#### 2.9. Peripherals

There are the following peripherals: CD-ROM optical disk, laser printer, streaming recorder, DAT hard disk, and 3-1/4 floppy disk.

Generally, the hard disk memory is greater than 1MB; the maximum hard disk memory is as high as 40MB.

Peripherals can be used to print tables, graphics, and status-setting.

#### 2.10. Machine case

The VME seven-unit high standard machine case (containing 20 slots) and the VME three-unit high standard machine case (containing seven slots) are used.

### III. 3301 CCSDS Modulation and Demodulation Section Made by Schlumberger Industries Corporation in France

This is a high-performance miniaturized and modularized item of equipment, carrying out all CCSDS requirements. There are modulation of convolutional code, code translation of Witt ratio, RS error-correcting code, solving RS error-correcting code, adding and solving CRC cyclic error-correcting code, multiple channel combined into virtual signal channel, solving of virtual signal channel, generation of frame synchronization, solving of frame synchronization, and carrying out code synchronization. A three-unit high VME standard machine case with seven slots is used for modulation and demodulation with CCSDS standard. There is included self-diagnostic functions, applying high-speed serial printing and single-chip integration technique, capable of detecting the malfunctioning site. The code rate is as high as three megacodes per second. In the future, development into 100 to 150 megacodes per seconds is possible.

#### 3.1. RS error-correcting code

The equipment includes RS error-correcting code with single chip modulation and demodulation, with application of (10,6) or (255, 233) RS error-correcting code with alternation of 1 to 5. There are 32 bits in the error-correcting code for each block of 223 data digits, capable of correcting 16-bit errors. There are status marking signals, capable of indicating such status as no error, errors have been corrected, and there are errors that cannot be corrected.

### 3.2. Time marking

There are internal clocks to transmit the data structure to users.

### 3.3. Status setting

Status setting is via Ethernet

### 3.4. CRC cyclic error-correcting code

The equipment has a CRC cyclic error-correcting code modulator, with 16 bits of correcting code. The polynomials are  $X^{16} + X^{12} + X^5 + 1$ . There is a status code bit to indicate the error correcting code result.

### 3.5. Multiplexing

The virtual signal channel is executed under the CCSDS standard.

### 3.6. Multi-status operation

For operation at this status, in the same transmission channel, several frames can apply the RS error-correcting code, or the CRC error-correcting code. However, some frames may not apply the error-correcting code.

### 3.7. Insertion

There is a continuous data region in the signal channel, capable of inserting or taking out synchronized data in 8-bit code in the frame's structure.

### 3.8. Input

1. Serial PCM data stream is inputted to the code synchronizer.

2. NRZ-L and time clock are inputted to the frame synchronizer.

### 3.9. Output

There are outputs of serial PCM NRZ-L and time clock. There are the standard TCP-IP and the UDP Ethernet communication interface.

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